

CLAIMS

We claim:

1. An apparatus for excluding objects from introduction into a controlled area, comprising:

a portal structure adapted to scan a human subject;

a substantially co-planar array of single axis magnetic field gradiometers mounted on said portal structure, each said gradiometer including a pair of magnetometers adapted to sense an induced magnetic field of an object, said magnetometers being oriented to have their sensitive axes parallel and in the plane of said gradiometer array;

at least one excitation coil establishing a magnetic excitation field adapted to induce said magnetic field of said object, said at least one excitation coil being oriented to cause said excitation field to have zero mutual inductance with said gradiometer array; and

a processor adapted to interpret signals from said gradiometer array to indicate the presence of said object.

2. The apparatus recited in claim 1, wherein said at least one excitation coil is oriented to cause said excitation field to have zero mutual inductance with each of said magnetometers.

3. The apparatus recited in claim 2, wherein said at least one excitation coil is oriented to cause said excitation field to have its axis orthogonal to said sensitive axes of said magnetometers.

4. The apparatus recited in claim 3, wherein said at least one excitation coil comprises a single excitation coil, said single excitation coil being substantially co-planar with said gradiometer array.

1 5. The apparatus recited in claim 4, wherein:
2 said gradiometer array comprises first and second gradiometer sub-arrays, said
3 sub-arrays being located on opposite sides of said portal structure;
4 said single excitation coil has first and second vertical legs;
5 said first vertical leg of said excitation coil bisects each said gradiometer of said
6 first sub-array, equidistant from each said magnetometer of each said
7 gradiometer of said first sub-array; and
8 said second vertical leg of said excitation coil bisects each said gradiometer of
9 said second sub-array, equidistant from each said magnetometer of each
10 said gradiometer of said second sub-array.

1 6. The apparatus recited in claim 3, wherein said at least one excitation coil
2 comprises two excitation coils, each said excitation coil being in a plane parallel to the
3 plane of said gradiometer array, said excitation coils being on opposite sides of, and
4 equidistant from, said plane of said gradiometer array.

1 7. The apparatus recited in claim 6, wherein said two excitation coils
2 comprise a Helmholtz coil arrangement.

1 8. The apparatus recited in claim 1, wherein said at least one excitation coil
2 is oriented to cause said excitation field to have zero mutual inductance with each of said
3 gradiometers.

1 9. The apparatus recited in claim 8, wherein said at least one excitation coil
2 is oriented to cause said excitation field to have its axis parallel to said sensitive axes of
3 said magnetometers.

1 10. The apparatus recited in claim 9, wherein said at least one excitation coil
2 is in a plane bisecting each said gradiometer, substantially equidistant from each said
3 magnetometer of each said gradiometer.

1 11. The apparatus recited in claim 10, wherein:
2 said gradiometer array comprises first and second gradiometer sub-arrays, said
3 sub-arrays being located on opposite sides of said portal structure;
4 said at least one excitation coil comprises first and second excitation coils;
5 said first excitation coil being in a first plane bisecting each said gradiometer of
6 said first sub-array, substantially equidistant from each said magnetometer
7 of each said gradiometer of said first sub-array; and
8 said second excitation coil being in a second plane bisecting each said
9 gradiometer of said second sub-array, substantially equidistant from each
10 said magnetometer of each said gradiometer of said second sub-array.

1 12. A method for excluding objects from introduction into a controlled area,
2 comprising:
3 providing a co-planar array of single axis magnetic field gradiometers mounted on
4 a portal structure, each said gradiometer including a pair of
5 magnetometers oriented to have their sensitive axes parallel and in the
6 plane of said gradiometer array;
7 providing at least one excitation coil;
8 energizing said at least one excitation coil to establish a magnetic excitation field,
9 while orienting said excitation coil to cause said excitation field to have
10 zero mutual inductance with said gradiometer array;
11 scanning a subject with said gradiometer array;
12 inducing a magnetic field in an object, with said excitation field;
13 sensing said induced magnetic field of said object, with said gradiometer array;
14 and
15 interpreting signals from said gradiometer array, with a processor, to indicate the
16 presence of said object.

1 13. The method recited in claim 12, further comprising energizing said
2 excitation coil with alternating current.

1 14. The method recited in claim 13, further comprising establishing said
2 alternating current with a frequency of less than approximately 3000 Hz.

1 15. The method recited in claim 12, further comprising orienting said at least
2 one excitation coil to cause said excitation field to have zero mutual inductance with each
3 of said magnetometers.

1 16. The method recited in claim 15, further comprising orienting said at least
2 one excitation coil to cause said excitation field to have its axis orthogonal to said
3 sensitive axes of said magnetometers.

1 17. The method recited in claim 16, wherein said at least one excitation coil
2 comprises two excitation coils, further comprising:
3 locating said excitation coils in planes parallel to, on opposite sides of, and
4 equidistant from, the plane of said gradiometer array;
5 energizing said two excitation coils to establish a substantially non-diverging
6 field across said portal structure.

1 18. The method recited in claim 12, further comprising orienting said at least
2 one excitation coil to cause said excitation field to have zero mutual inductance with each
3 of said gradiometers.

1 19. The apparatus recited in claim 18, further comprising orienting said at
2 least one excitation coil to cause said excitation field to have its axis parallel to said
3 sensitive axes of said magnetometers.